

LCLUC Abstract

Quantifying Grassland-to-Woodland Transitions and the Implications for Carbon and Nitrogen Dynamics in the Southwest United States

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Environmental impacts associated with slashing and burning of tropical rain forest have received considerable attention and are the focus of much current research. However, reductions in biomass associated with deforestation are in stark contrast to vegetation changes occurring on many arid/semi-arid rangelands, where grasslands and savannas are being replaced by shrublands and woodlands. Though not well quantified on a global scale, this vegetation change has been widely reported in tropical, temperate and high-latitude rangelands worldwide (Archer 1994). These changes in vegetation structure are relevant to global change as (a) they may reflect historical shifts in climate and land use and (b) they may influence biodiversity, productivity, above- and belowground carbon and nitrogen sequestration and biophysical aspects of land surface/atmosphere interactions.

Our overall goal is to investigate how changes in the relative abundance of herbaceous and woody vegetation affect carbon and nitrogen dynamics across topographically diverse landscapes. Grassland-to-woodland transitions occur at small scales relative to the spatial resolutions of current and planned sensors having regional- to continental-scale monitoring capabilities (e.g. AVHRR, MODIS). The functional properties of heterogeneous savannas and shrub/woodlands will likely go undetected by single indices such as the NDVI as structural and background factors confound the remotely sensed signal. We propose to refine and apply a sub-pixel analytical technique (spectral mixture analysis) to determine grass-woody fractional cover. By linking actual land-cover composition with a process-based ecosystem model, Century, we will generate explicit predictions of the C and N storage in plants and soils resulting from changes in vegetation structure. We will base our studies on a grassland-to-woodland chronosequence in Texas which represents the range in vegetation structure expected in the southwestern United States and having functional counterparts in Central and South America, Africa, Asia and Australia. Our specific objectives will be to (1) continue development and test applications of spectral mixture analysis across grassland-to-woodland transitions; (2) quantify temporal changes in plant and soil C and N storage and turnover for remote sensing and process model parameterization and verification; and (3) couple landscape fraction maps to Century to observe biogeochemical dynamics under changing landscape structure and climatological forcings. We will utilize high spectral and spatial resolution data (AVIRIS, TM, and Landsat) to establish landscape-level predictions and then extrapolate to the southwestern United States using MODIS and readily available climate data.